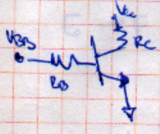
TE - Reposo

! En los ejercicios con polarización por divisor de tensión, DESPRECIAMOS la CORRIENTE DE BASE, pero no es cierto.



Q?

$V_{BB} = 5v$ $R_B = 1M$

$V_{CC} = 12v$ $R_C = 1k$

$\beta = 300$

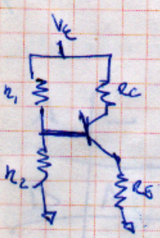
Q(10'71v, 1'29mA)

$I_B = \frac{V_{BB} - V_{BE}}{R_B} = \frac{5 - 0'7}{1M} = 4'3\mu A$ $I_C = I_B \cdot \beta = 1'29mA$

$V_C = V_{CC} - I_C \cdot R_C = 12 - 1'29mA \cdot 1k = 10'71v$

Si $R_B = 100k$

$I_B = 43\mu A$ $I_C = 12'9mA$ $V_{CE} = 12v - 12'9mA \cdot 1k = -0'9v$ saturación!



$R_1 = 10k$

$R_2 = 2k2$

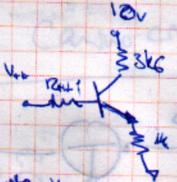
$R_C = 3k6$

$R_E = 1k$

$\beta = 200$

$V_{CC} = 10v$

Q?



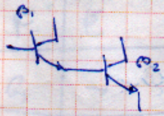
$V_{TH} = \frac{10 \cdot 2k2}{12k2} = 1'8v$

$R_{TH} = 1k8$

$I_B = \frac{1'8 - V_{BE} - 1k \cdot I_E}{1k8}$ $1k8 I_B = 1'8 - 0'7 - 1k \cdot 200 I_B$

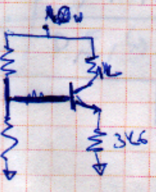
$I_B = \frac{1'1}{1k8 + 200k} = 5'45\mu A$ $I_E = 1'09mA$

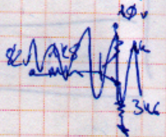
$V_{CE} = (10 - 3k6 \cdot 1'09mA) - (1k \cdot 1'09mA) = 4'98$

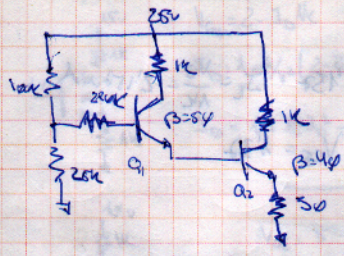


$I_{E_1} = I_{B2} = I_{B1} \cdot \beta_1$

$I_{E_2} = I_{B1} \cdot \beta_1 \cdot \beta_2$







$I_{C_1} = 9\mu A \cdot 50 = 450\mu A$

$I_{C2} = I_{E2}$

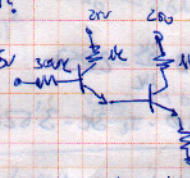
$V_{E2} = 16mA \cdot 5\Omega = 0'9v$

$V_{B1} = 0'9 + 0'7 = 1'6v$

$V_{C2} = 25 - 16mA \cdot 1k = 7v$

$V_{C_1} = 25 - 450\mu A \cdot 1k = 24'55v$

Q?



$I_{E_2} \cdot 50 + 0'7 + 0'7 + I_{B1} \cdot 300k = 5$

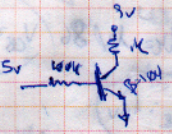
$50 \cdot 40 \cdot I_{B1}$

$(100k + 300k) I_{B1} = 3 - 1'4$ $I_{B_1} = 9\mu A$

$I_{E_2} = 18mA$

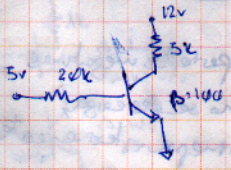
$V_{CE_1} = 22'95v$ $Q_1 (22'5v, 450\mu A)$

$V_{CE2} = 6'1v$ $Q_2 (6'1v, 18mA)$



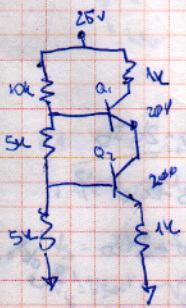
$I_C = \frac{5 - 0'7}{100k} = 43\mu A$ $V_C = 9v - 1k \cdot 43mA = 4'7v$

$Q (4'3mA, 4'7v)$



$I_B = \frac{5 - 0'7}{20k} = 215\mu A$ $I_C = 21'5mA$

$V_C = 12v - 21'5mA \cdot 5k = -95'5v$ → saturación!



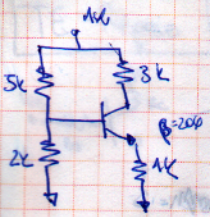
Q?

$V_{B_1} = 25 \cdot \frac{10k}{200k} = 12'5v$ $V_{E2} = 11'8v = V_{C2}$

$V_{B2} = 25 \cdot \frac{5k}{20k} = 6'25v$ $I_{E_2} = \frac{5'55}{1k} = 5'55mA$

$V_{C_1} = 25 - 5'55mA \cdot 1k = 19'45$ $V_{CE1} = 7'65v$ $V_{CE2} = 6'25v$

$Q_1 (7'65, 5'55mA)$ $Q_2 (6'25, 5'55mA)$

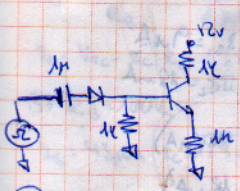


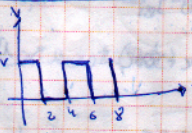
Q?

$V_B = 10 \frac{2k}{1M} = 2'85V$ $V_E = 2'15V$ $I_E = \frac{V_E}{1k} = 2'15mA$

$V_C = 10 - I_E \cdot 3k = 3'52V$ $V_{CE} = 1'37V$

$Q(2'15mA, 1'37V)$



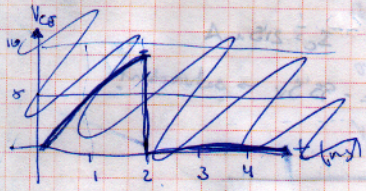


t_0: $V_B = 4'3V$ $I_E = \frac{4'3V}{1M} = 4'3mA$ $V_C = 12 - 4'3mA \cdot 1k = 7'2V$ $V_{CE} = 8'4V$

t_1: $V_C = V_f + (V_i - V_f) e^{-t/\tau} = 5 + (0 - 5) e^{-1ms/1ms} = 3'16V$

$V_B = 5 - 3'16 = 1'839$ $I_E = 1'839mA$ $V_C = 12 - 1'839 \cdot 1k = 10'16$ $V_{CE} = 8'32$

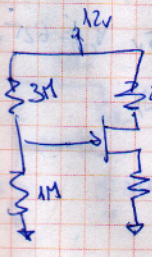
t_{2c}: $V_C = 4'32V$ $V_B = 0'677V$ $V_E = -0'23$ corte $V_{CE} = 12V$



t_{2+}: $V_B = -4'32V$ → corte

t_3: [illegible] → corte

¡Como en los periodos negativos el condensador no se descarga, el transistor siempre está en corte y $V_{CE} = 12V$.



$\beta = 1mA/V^2$ $V_{GS(off)} = -3V$

$V_G = 12 \frac{1M}{4M} = 3V$ $V_S = 3V - 2k I_D$

$I_D = \beta (V_{GS} - V_{GS(off)})^2$ $I_D = 1 (3 - 2k I_D + 3)^2$

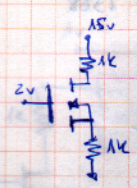
$I_D = 6^2 + 4I_D^2 - 24 I_D$

$4I_D - 25 I_D + 36 = 0$ $I_D < \begin{matrix} 2'25mA \rightarrow V_{GS} = -1'5 \\ 4mA \rightarrow V_{GS} = -5 \end{matrix}$ (no válido)

$V_D = 12V - 2k \cdot 2'25mA = 7'5V$ $V_{DS} = 4'5V$

$V_{DS} = 7'5 - 2k \cdot 2'25mA = 3V$ → $> -(-3)$ válido

$Q(2'25mA, 3V)$



$V_{GS} = 2 - I_D \cdot 1k$

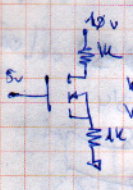
$I_D = 1 mA/v^2 (2 - I_D \cdot 1k - 1)^2$

$I_D = 1 + I_D^2 - 2I_D$

$I_D \begin{cases} 0'382\ mA \rightarrow V_{GS} = 1'618 \rightarrow ok!\ ON \\ 2'618\ mA \rightarrow V_{GS} = -0'618 \end{cases}$

$V_D = 15 - 0'382mA \cdot 1k = 14'618$ $V_{DG} = 12'618$ Activa!

$V_{DS} = 14'618 - 0'382 =$ $V_{DS} > V_{GS} - V_{th}$



$V_{GS} = 5 - I_D \cdot 1k$

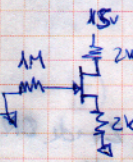
$I_D = 3mA/v^2 (3v - I_D \cdot 1k - 1v)^2$

$3I_D^2 - 25I_D + 48 = 0$

$I_D \begin{cases} 3mA \rightarrow V_{GS} = 2v \rightarrow ok!\ ON \\ 5'33mA \rightarrow V_{GS} = -0'33v \end{cases}$

$V_D = 10 - 3 = 7v$ $V_{DG} = 7 - 5 = 2v$ activa!

$V_{DS} = 7 - 3 = 4v$



¿? region?

$V_{GS} = 0 - 2I_D$

$I_D = (0 - 2I_D + 1)^2$

$4I_D^2 - 5I_D + 1 = 0$

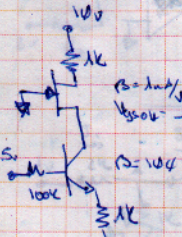
$V_{DS} = 14'5 - 0'5 = 14$

$V_{GS(th)} = -1v$ $\beta = 1mA/v^2$

$I_D \begin{cases} 0'25mA \rightarrow V_{GS} = -0'5v \rightarrow ok!\ ON \\ 1mA \rightarrow V_{GS} = -2v \end{cases}$

$V_D = 15 - 0'5v = 14'5$ $V_{DG} = 14'5v > -(-1v)$ activa!

$\rightarrow (14v, 0'5mA)$



$I_B \cdot 100k = 5v + 0'7 + 100 I_B \cdot 1k$

$5 - I_B 100k - 0'7 - 100 I_B \cdot 1k = 10$

$I_B \dfrac{14'3}{200k} = 0'0215mA$ $I_E = 2'16mA$

$I_D = I_E$ $V_D = 10 - 2'15 = 2'85v$

$2'1 = 1 (V_{GS} + 2)^2$

$2'1 = V_{GS}^2 + 4 + 4V_{GS}$ $V_{GS} \begin{cases} 0'665 \rightarrow ok!\ ON \\ -4'665 \rightarrow \end{cases}$ $V_{DG} = 2'85 - 0 = 2'85 > 2$ activa!

$V_S = -0'665$ $V_{DS} = 2'85 + 0'665 = 3'51$

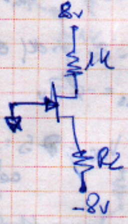
$V_C = V_S$ $V_{CE} = -0'665 - (2'15 - 10) = 2'185$

Calcular R_2 si sabemos $I_D = 2mA$ 1.568

$\beta = 1mA/V^2$ $V_{GS\,off} = -2V$

$40 \pm \frac{\sqrt{40^2 - 16 \cdot 98}}{8}$

$40 \pm \frac{5'6568}{8}$



$V_{GS} = 0 - (R2\,2mA - 8_V)$

$2 = 1(8 - R2 \cdot 2 + 2)^2$

$2 = 100 + 4R2^2 - 40R2$

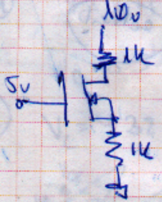
$4R_2^2 - 40R_2 + 98 = 0$ $R_2 <$ $\boxed{4'29k}$ → $V_{GS} = -0'58$ ok ON; $5'2k$ → $V_{GS} = -3'4$

~~$R_2 = 4'29k$ → ... $V_{GS} = 4'29 - 8 = -3'71$~~

~~$R_2 = 5'2k$ → ... $V_{GS} = 5'2 - 8 = -2'3$~~

$V_D = 8 \cdot 2 = 6V$ $V_{DG} = 6_V > +2_V$ → activa

$V_{DS} = 5'42V$



$k = 6mA/V^2$ $V_t = 1V$ M?

$V_{GS} = 5 - I_D \cdot 1k$

$I_D = 3(5 - I_D + 1)^2$

$I_D = 3I_D^2 + 48 - 24I_D$

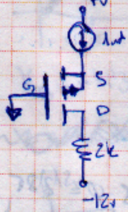
$3I_D^2 - 25I_D + 48 = 0$

$I_D <$ $3mA$ → $V_{GS} = 2_V$ ok ON; $5'3mA$ → $V_{GS} = -0'3V$

$V_{DG} = (10 - 3 = 7) - 5 = 2V > 1V$ activa

$V_{DS} = 7 - 3_V = 4V$

M $(3mA, 4V)$



$V_t = -2V$ $k = 2mA/V^2$ V_{SD}? M?

~~...~~

~~... activa~~

$V_{GS} = 0 - V_S$

$1 = 1(-V_S + 2)^2$ → $1 = V_S^2 + 4V_S + 4$ → $V_S <$ 1_V → $V_{GS} = -1_V$; 3_V → $V_{GS} = -3_V$ ok ON

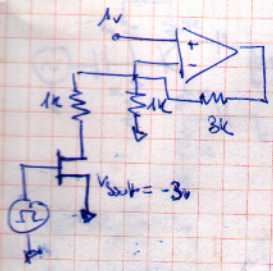
$V_D = -12_V + 2k \cdot 1mA = -10V$ $V_{DG} = -10_V < V_t$ → activa

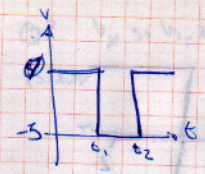
$V_{DS} = -10_V - (-3_V) = -7V$ M $(1mA, -7V)$

$V_I = 7_V + 3_V = 10V$

$10 = 9(1 + \frac{y}{10k})$

$9 \cdot 10k = y = 90k$

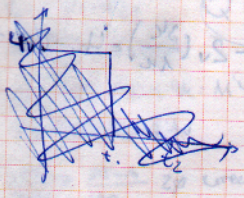


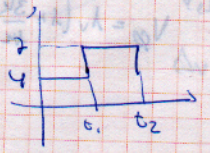


V_D?

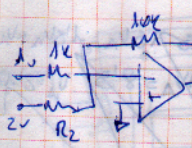
If $V_{in} = -5V$ $V_{GS} = -5V \rightarrow$ OFF

If $V_{in} = 0V$ $V_{GS} = 0V \rightarrow$ ON





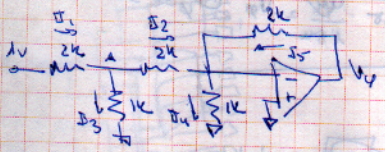
$1\left(1+\frac{3k}{1k}\right)$ $1\left(1+\frac{3k}{0'5k}\right)$



R_2 para $V_0 = 12$?

$V_0 = -1\frac{100k}{1k} - 2V\frac{100k}{R_2}$

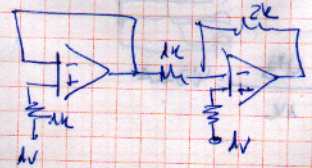
$-12 + 10 = -2V\frac{100k}{R_2}$ $R_2 = -\frac{2V\,100k}{-2V}$ $R_2 = 10k\Omega$



Calcular V_0 por corrientes.

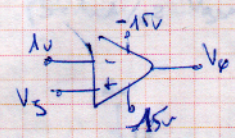
$\frac{1-V_A}{2k} = \frac{V_A - 0}{2k} + \frac{V_A - 0}{1k}$ $1 - V_A = V_A + 2V_A$ $V_A = \frac{1}{4}$

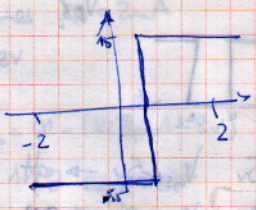
$\frac{1}{4} + V_0 = 0$ $V_0 = -\frac{1}{4}V$ $\frac{V_A - 0}{2k} + \frac{V_0 - 0}{2k} = \frac{0-0}{1k}$

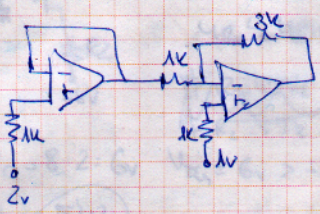


$V_0 = 1V\left(1+\frac{2k}{1k}\right) - 1V\left(\frac{2k}{1k}\right) = 1V$

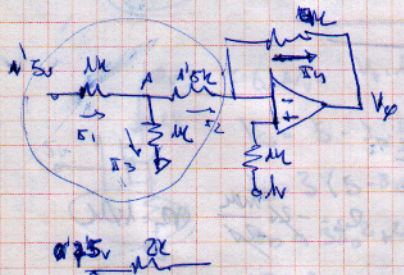
V5 [2, 2]



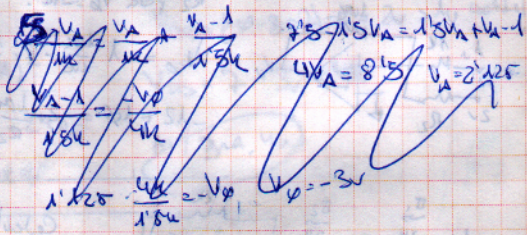




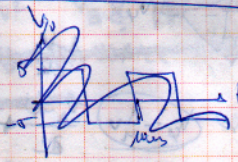
$V_\varphi = 1_V\left(1+\frac{3k}{1k}\right) - 2_V\left(\frac{3k}{1k}\right) = 4_V - 6_V = -2_V$



$V_\varphi = 1\left(1+\frac{4k}{2k}\right) - 0'75\left(\frac{4k}{2k}\right) = 3'15 = 1'5V$

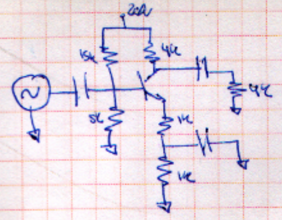


$A_v = \frac{3k \,//\, 4k}{1000\Omega + \frac{25mV}{I_e = 4'3mA}} \simeq 16'2\varphi$



$Z_e = (4k \,//\, 5k) \,//\, (1000 + \frac{25mV}{I_e = 4'3mA}) \simeq 1k\varphi$

$V_B = 20\,\frac{5k}{20k} = 5V$ $\quad V_5 = 0'2 + I_e R_{e1} + I_e \cdot R_{e2}$ $\quad \frac{4'3}{1k} = 4'3mA$



Q? V_0 si V_i 10mV?

$\beta = 100$

$V_B = 20v \frac{5k}{20k} = 5v$

$V_E = 5 - 0'7 = 4'3v$

$I_E = \frac{4'3v}{2k} = 2'15mA$

$V_C = 20 - 2'15mA \cdot 4k = 11'4v$

$V_{CE} = 11'4 - 4'3 = 7'1v$

$\frac{20}{20k} > \frac{2'15mA}{100} \cdot 20$ correcto

Q (7'1v, 2'15mA)

$Z_{base} = (R_{E_1} + r'e)\beta = (1k + \frac{26mV}{2'15mA})100 = 101'16k$

$Z_{entrada} = (R_1 \| R_2) \| 101'16k = 3'62k$

$A_V = \frac{-r_c}{R_{E_1} + r'e} = \frac{-2k}{1'01k} = -1'977$

DSED - Reposo

X Y	
0 0	A
0 1	B
1 0	C
1 1	D